redundant • abundant • affordable

Lake County Broadband Assessment

Frank Ohrtman

December 31, 2013

Executive Summary

This report provides an assessment of the broadband environment for Lake County, Colorado. The methodology for this assessment involved 3 elements: a) speed mapping b) resource mapping and c) demand mapping.

Speed Mapping
Speed mapping refers to a process of gathering a) advertised speeds (internet speeds reported by service providers to state and federal authorities) and then comparing them to b) actual speeds or what the subscriber actually receives from the service provider. This assessment found a wide disparity between advertised and actual internet speeds. Of note, broadband, as defined by the Federal Communications Commission as 4 Megabits per second downstream, 1 megabit per second upstream, is available only in downtown Leadville (population 2,600 of a countywide total of 7,800) only.

Resource Mapping
Assessing the resources that comprise potential broadband infrastructure provides an explanation for a) deficiencies in the broadband network and b) resources that might improve the broadband environment. This assessment found few middle mile resources, which could contribute to an improved middle mile market. In short, the middle mile market is not "redundant, abundant nor affordable".

Demand Mapping
Any business case would take potential sales (demand) into account in synch with any potential investment in infrastructure. Surveys of both residential as well as enterprise (community anchors and businesses) indicate that demand exceeds what is available from service providers.

Analysis
Lake County is in dire need of significant investment in its broadband environment including:

1. Redundant, abundant, affordable middle mile
2. Ubiquitous broadband last mile infrastructure serving as many residences, businesses and community anchor institutions in Lake County as possible

Recommendations
It is recommended that this report be made to the public (demand) and service providers (supply). In conjunction with publishing this report, Lake County Governments should issue a Request for Information inviting service providers to provide information on how they would improve the broadband environment in Lake County.

Table of Contents

Introduction

A three-part mantra drives rural broadband development in Colorado:

(1) No one size fits all
(2) The best solutions are local
(3) It does NOT cost millions of dollars to bring broadband to any rural Colorado community

Further more, a methodology known as "the 5 A's" provides a robust means for community planners in improving their broadband environment. Those "5 A's" are:

(1) Aggregate Experience
(2) Assess Broadband Environment
(3) Assess and Aggregate Demand
(4) Adopt Existing Resources and Solutions
(5) Adapt for Sustainability

This Assessment is comprised of three mapping processes

1) Speed Mapping
2) Resource Mapping
3) Demand Mapping

The data gathered, summarized and reported is designed to help community leaders and service providers alike understand the current broadband environment and guide them in making decisions to improve the broadband environment.

Speed Mapping

Broadband is defined by the Federal Communications Commission as being a downstream speed of 4 megabits per second (Mbps) and upstream speed of 1 Mbps. Until that condition is met, a subscriber does not have broadband. Monitoring of internet speeds is the first step in assessing one's broadband environment.

Internet speeds are classified in two categories by the FCC and national Telecommunications and Information Administration (NTIA): a) advertised speeds or that which the service provider advertises as being the speed available in a given market b) actual speeds based on internet speed tests. The following figures provide contrasts in advertised speeds for Lake County as gathered by Colorado Broadband Data and Development for the Colorado and National Broadband Maps versus speed test data gathered in a survey by Lake County, Internet3 and Mobile Pulse.

Advertised Speeds

The following figures detail advertised speeds for Lake County.

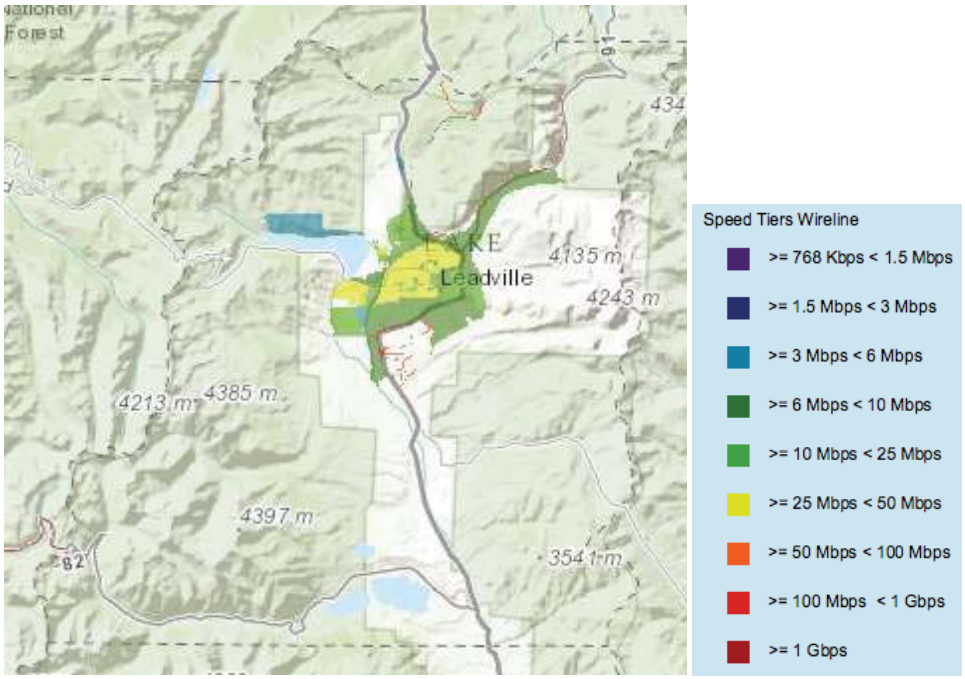

Figure 1 Advertised speeds for Lake County indicate Leadville has access of up to 50 Mbps internet speeds on wireline (telephone company infrastructure or cable modem)

Source: Colorado Broadband Data and Development Program
http://www.colorado.gov/oit/broadband

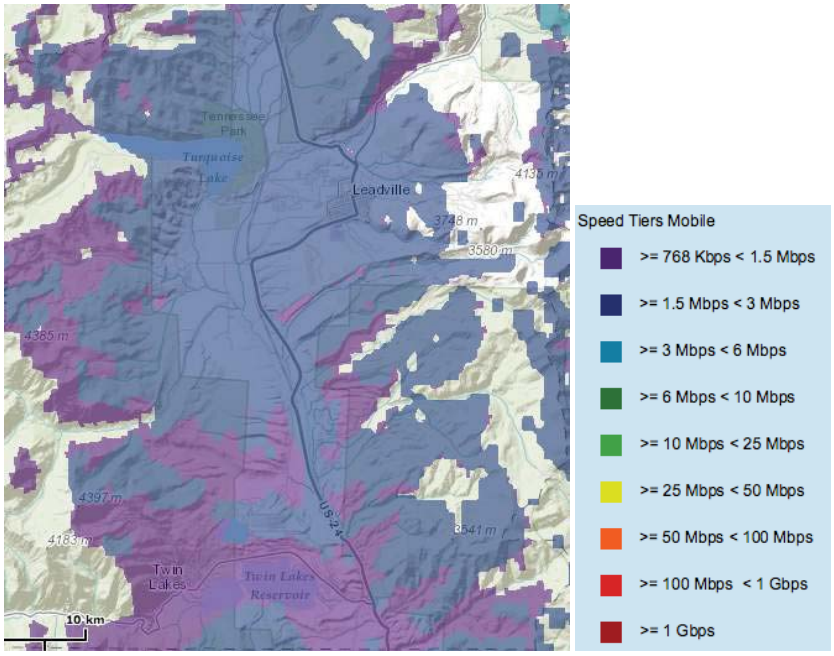

Figure 2 Map of advertised mobile (cellular) speeds for Lake County indicate speeds of up to 6 Mbps on mobile devices.

Source: Colorado Broadband Data and Development Program

http://www.colorado.gov/oit/broadband

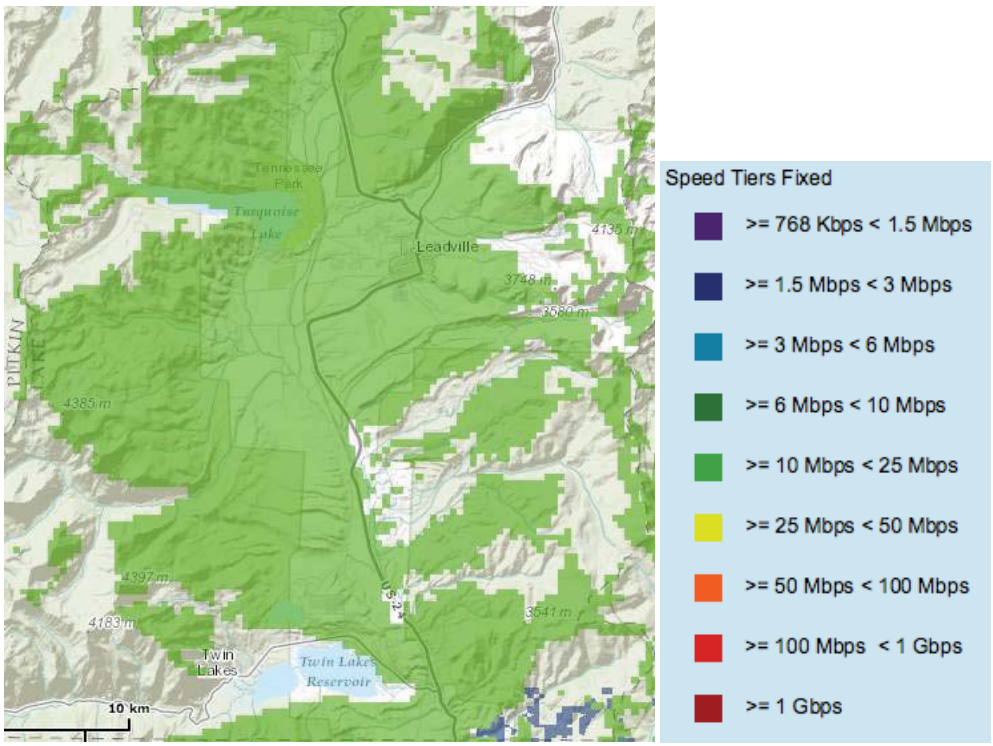

Figure 3 Map of advertised fixed wireless speeds indicates speeds of up to 25 mbps are available throughout Lake County. No actual tests collected support this.

Source: Colorado Broadband Data and Development Program
http://www.colorado.gov/oit/broadband

Actual Speeds

LakeConnect, the Local Technology Planning Team for Lake County, gathered speed test data in late 2012/early 2013. Almost 100 tests were analyzed to determine where broadband, as defined by the Federal Communications Commission (FCC) as 4 megabits per second (Mbps) downstream and 1 Mbps upstream, might be available. In contrast to the "advertised" speed data gathered for inclusion in the National and Colorado Broadband Maps, the map that follows is based on the data gathered.

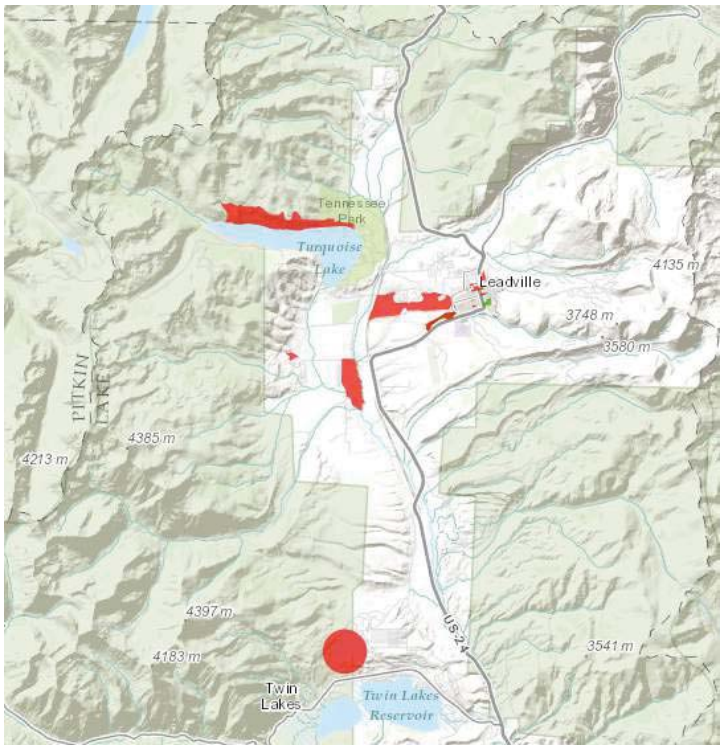

Figure 4 Speed tests gathered by Colorado Broadband Data and Development Program. A green dot represents a speed test where the subscriber got 3 Mbps downstream and 1 Mbps upstream. A red dot indicates a test that did not achieve those speeds.

Source: Colorado Broadband Data and Development Program
http://www.colorado.gov/oit/broadband

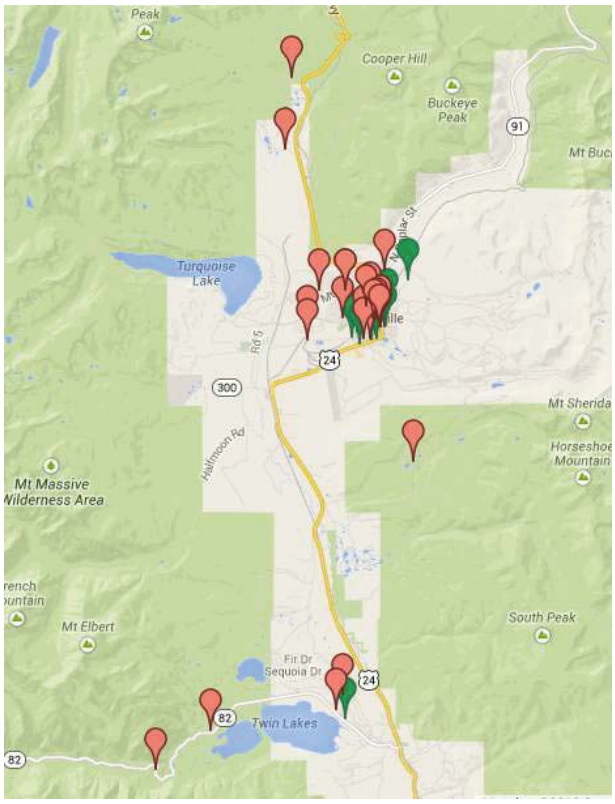

Figure 5 Actual speeds for Lake County as gathered by LakeConnect. Each point represents a speed test that met FCC definition of broadband (4 Mbps down, 1 Mbps up). Of almost 100 tests, less than 10% met the broadband criteria. Median download speed is 5.425 Mbps, median upload speed is 1.755 Mbps

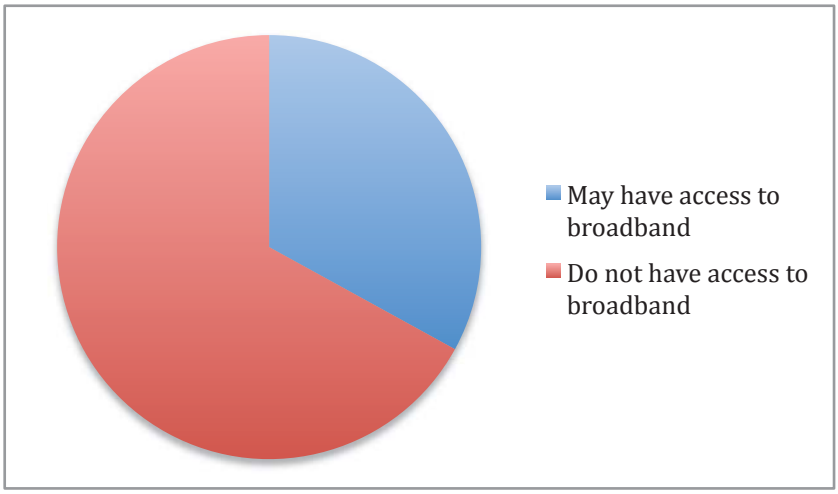

Figure 6 At least two-thirds of the population of Lake County have no access to broadband

Identify and catalog most challenged communities

Based on actual speed testing, all communities of Lake County are challenged in terms of internet speeds and reliability of the infrastructure.

Outages

Many respondents to the LakeConnect survey reported frequent network outages.

Of note, Chaffee County's Mountain Mail reported the following outage of June 2012:

Cut cable kills internet, phone

Posted: Thursday, June 7, 2012 8:52 am

Joe Stone, Mail News Editor | 0 comments

Internet and phone service went down in Chaffee County Wednesday afternoon when a fiber-optic cable was inadvertently cut Wednesday afternoon along U.S. 285 in southern Chaffee County.

Mark Bittle, CenturyLink spokesperson, said a nearby work crew responded almost immediately, restoring service in less than 2 hours.

Verizon Wireless spokesperson Bob Kelley said the damaged cable caused service outages at four Verizon cellular towers between Salida and Leadville.

Bittle said this and other recent service interruptions underscore the need for redundancy in the regional fiber-optic network, an issue the Chaffee County Economic Development Corp. has identified as a top priority.

Bittle said CenturyLink has listened to concerns expressed by the CCEDC and has diverted funds to build a redundant fiber-optic path that will prevent service outages when completed.

Bittle estimated that the new cable will be complete "within a year for sure."

While it might be an interesting exercise to determine the cost of a CenturyLink network outage in dollars per hour in a) lost sales by retailers, b) lost productivity in the public sector (schools, city and county governments) and c) the private sector ($/hour/employee), suffice it to say that the outage of October 31, 2011 cost Steamboat Springs retailers at least $100,000/hour for 8 hours or $800,000 in lost sales. From a community perspective, the expenses (capital and operating) of the CNL pale in comparison to the cost of just one more CenturyLink middle mile outage.

COST OF NETWORK OUTAGE IN LOST SALES OCT 31, 2011 ($100,000/HOUR X 8 HOURS)	COST OF NETWORK OUTAGE IN LOST PRODUCTIVITY (# WORKERS X $30/HOUR X 8 HOURS)	TOTAL COST OF OUTAGE 31 OCT 2011	ONE TIME COST OF CNL	SAVINGS TO COMMUNITY OVER ONE NETWORK OUTAGE
$800,000	1,000x$30x8=$240,000	$1,040,000	$70,000	$940,000

Table 7 Worksheet for determining cost of network outages for Steamboat Springs

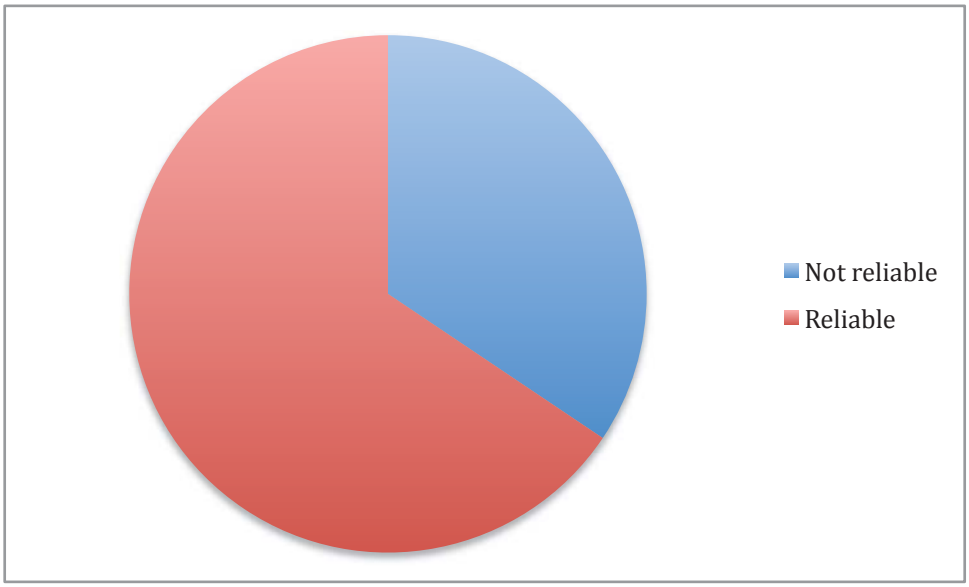

Figure 8 One-third of respondents reported their internet service is not reliable

Availability %	Downtime per year	Downtime per month*	Downtime per week
90% ("one nine")	36.5 days	72 hours	16.8 hours
95%	18.25 days	36 hours	8.4 hours
97%	10.96 days	21.6 hours	5.04 hours
98%	7.30 days	14.4 hours	3.36 hours
99% ("two nines")	3.65 days	7.20 hours	1.68 hours
99.5%	1.83 days	3.60 hours	50.4 minutes
99.8%	17.52 hours	86.23 minutes	20.16 minutes
99.9% ("three nines")	8.76 hours	43.8 minutes	10.1 minutes
99.95%	4.38 hours	21.56 minutes	5.04 minutes
99.99% ("four nines")	52.56 minutes	4.32 minutes	1.01 minutes
99.999% ("five nines")	5.26 minutes	25.9 seconds	6.05 seconds
99.9999% ("six nines")	31.5 seconds	2.59 seconds	0.605 seconds
99.99999% ("seven nines")	3.15 seconds	0.259 seconds	0.0605 seconds

Table 1 Why downtime matters: "five nines" or 99.999% up time is the standard for the industry. For comparison, a household in Denver can expect 99.999% uptime where Gilpin and Clear Creek county homes and businesses may suffer as low as 99.9% uptime-a significant difference in telecom standards.

Resource Mapping

Why does a community's internet "stink"? Most likely it is due to inadequate infrastructure and other resources. The next step in solving the problem is to list and map telecom infrastructure resources. The most critical of which are middle mile resources, i.e., the connection to the outside world.

Inventory of Middle Mile Assets

Middle mile, the "pipe" that connects communities to the outside world, comes in two technology types: fiber optic cable and microwave (wireless).

Fiber Optic Cable Routes

Fiber optic cable is generally deployed in two "flavors": aerial (strung along power transmission or distribution lines) and terrestrial (trenched in conduits usually along highway rights of way.

Aerial Routes

Electric utilities' infrastructure can be used for broadband services. Fiber optic cables can be attached to electric utility poles to deliver both middle and last mile services.

Sangre de Cristo Electric Association

South Lake County is served by Sangre de Cristo Electric Association, a not-for-profit electric cooperative.Sangre de Cristo Electric Association has no aerial fiber deployed on their assets in Lake County. Sangre de Cristo management is enthusiastic to work with Lake county to improve the broadband environment.

A search of US Forest Service filings indicate CenturyLink uses (or used) aerial fiber at a one-mile stretch of their middle mile serving lake County.

Qwest Corporation dba Centurylink QC CE	- Special use management	In Progress: 215 Comment Period Legal Notice 06/29/2012	Expected:08/2012	08/2012	Jon Morrissey 719-486-0749 jmorrissey@fs.fed.us
	Description: Proposed action involves issuing a new special use permit for placement of 6622.2 feet of aerial fiber optic cable on existing power poles.				
	Location: UNIT - Leadville Ranger District. STATE - Colorado. COUNTY - Chaffee. LEGAL - NE1/4 Section 21, Township 12 South, Range 79 West ,and the W1/2 and SE1/4 Section 27, Township 12 South, Range 79 West, all in the 6th Principal Meridian. Just off Highway 24, approximately three (3) miles south of Granite, Colorado,.				

Figure 9 Sample of Forest Service filings by CenturyLink for aerial fiber work near Granite, CO
Source: http://www.fs.fed.us/sopa/components/reports/sopa-110212-2013-04.html

Xcel Energy

Xcel Energy is the electric provider for Leadville and north Lake County. Per the Telecommunications Act of 1996, for-profit electric utilities such as Xcel, must make their poles and other facilities available to telecom service providers. Additional rulings from the FCC have set pricing for use of utility poles at about $5/year.

As a result, any Xcel Energy pole could be used for middle mile services. For example, fiber optic cabling attached to Xcel poles could bring competitive gigabit

per second speeds to Leadville, Twin Lakes and any other cluster of businesses and residences.

Utility poles can also support last mile broadband where aerial fiber optic cables attached to utility poles delivering fiber-to-the-home broadband services. Of note, San Luis Valley Rural Electric Cooperative is currently planning such a network.

Terrestrial Fiber Routes - CenturyLink

There is only 1 commercially operated middle mile fiber optic service provider in Lake County: CenturyLink. As the route map below indicates, this route should provide north-south route diversity such that in the event of a cut in the line, traffic should be rerouted in the direction opposite the cut. Recent CenturyLink fiber optic cable cuts (NW CO October 31, 2011, Chaffee County June 06, 2012) do not support that claim.

Figure 10 CenturyLink fiber optic cable route in Lake County

Colorado Department of Transportation (CDOT) and Comcast

One possible solution toward ensuring middle mile services to Lake County are "redundant, abundant and affordable" is to connect to fiber optic route(s) on Interstate 70.

Figure 11 CDOT operates a 144-strand fiber route Golden to Vail of which 2 strands are leased to Comcast. Leadville could connect to that route via Xcel energy utility poles along Hwy 91

CDOT-ITS Fiber Sharing Policies and Primary Agreements

Colorado Department of Transportation has a fiber optic route stretching from Golden to Vail along I-70. That route has 144 strands of fiber. Comcast has use (lease) of 2 fibers for 20 years. Comcast provides all maintenance, including locates, on the line and Comcast pays CDOT ITS $300,000/year cash ($6M total) + consulting services over the term for a total contribution of approximately $15M.

CDOT maintains control of our existing fiber asset to use, lease, etc. "The department shall not enter into any exclusive arrangement, lease, or other agreement for use of

the public rights-of-way by a telecommunications provider that in any way discriminates or prevents a similar arrangement being made with any other telecommunications provider."

Any public or private entity may approach CDOT or any party to discuss availability and terms for use of that entities asset. Public sector requests to CDOT may be considered based on in-kind services and/or matters of public safety. In short, all ITS fiber optic strands are open for public or private use, provided that there are fiber strands available for use, and if a partner is able to provide in-kind benefit to CDOT, as noted in the statutes referenced above.

EAGLE-Net

The most recent map from EAGLE-Net ($100.6 million federal grant to build fiber optic routes to Colorado's 178 school districts) shows a planned terrestrial fiber optic cable route from Interstate 70 to Leadville. Earlier versions of the same map indicated that route would be completed by August 30, 2013 (the end date of federal funding). The planned route was to have been constructed along CO 91 connecting to a yet-to-be-constructed (or leased) route along Interstate 70.

Figure 12 EAGLE-Net's December 2013 map of facilities for Lake County (or lack thereof). It is unlikely EAGLE-Net will build to Lake County.

Microwave

Microwave radios can transmit multiple gigabits per second at ranges of over 50 miles at costs of less than $5,000/mile (compare to trenched fiber which starts at $25,000/mile and aerial fiber at $15,000/mile). Microwave is a relatively low cost middle mile solution for many rural and remote communities.

American Tower

Figure 13 American Tower, a leading cell tower operator, has a tower in Leadville that can support microwave operations.

Consolidated Communications Network of Colorado (CCNC)

Colorado is home to the nation's largest public safety two-way radio network, the CCNC with 216 tower sites and over 60,000 public safety subscribers. The figure below illustrates CCNC microwave sites in Lake County and Denver. The microwave towers illustrated are often located on "antenna farms" where commercial space can be had by commercial service providers who could contribute to improved middle miles services in Lake County.

Figure 14 Map of CCNC site in Lake County. If not available for commercial use, near by towers can be used for commercial purposes
http://ccncinc.org/images/stories/maps/jan2011_sites.gif

Lake County Wireless Towers

Lake County Government owns and operates 2 radio towers: Quail Mountain and Lake County Courthouse.

Figure 15 Lake County Government owns towers at Quail Mountain and Lake County Courthouse

Summary of Middle Mile Resources

Middle Mile Technology	Route/Location	Vendor/Operator
Fiber optic cable	Hwy 24 and 91	CenturyLink

Table 2 Last mile providers in Lake County have access to 1 middle mile resource

Inventory of Last Mile Providers by Community

Last mile providers connect subscribers to the Internet. A survey conducted by Lake Connect in February, 2013, gathered responses from 23 respondents.

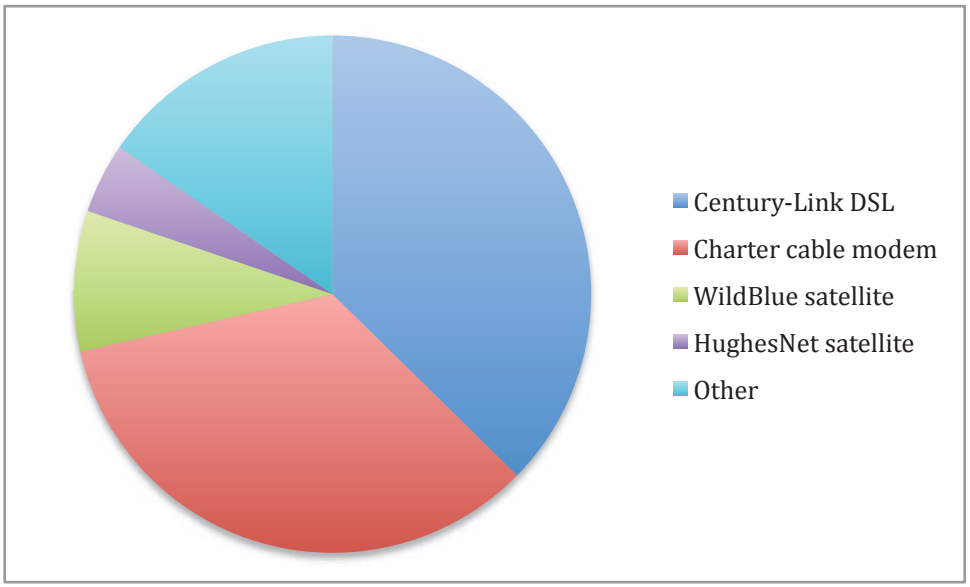

Figure 16 How Lake County accesses the Internet

Almost half of respondents reported subscribing to cable modem service. This is probably due to a) small footprint for coaxial cable infrastructure (Leadville only) b) aging coaxial cable infrastructure c) the cable modem provider (now Charter Communications) probably buys middle mile services from CenturyLink. It is not clear why Charter does not offer Denver-area speeds (50 mbps and 100 Mbps packages) in the communities it serves in Lake County.

Town	Providers
Leadville	CenturyLink Charter AT&T Verizon Amigo net
Twin Lakes	CenturyLink AT&T Verizon

Table 3 Inventory of last mile providers by town

Inventory of Switching Facilities

Traditionally, telecommunications services have been routed through the telephone company's central office. Leadville's broadband environment is no exception.

Town	Street Address
Leadville	411 Poplar St. Leadville, CO

Table 4 Location of CenturyLink central office for Lake County. Almost all speed tests that met FCC definition of broadband occurred within 1 mile of the central office. Comcast's cable plant is limited to Leadville city limits and buys middle mile services from CenturyLink.

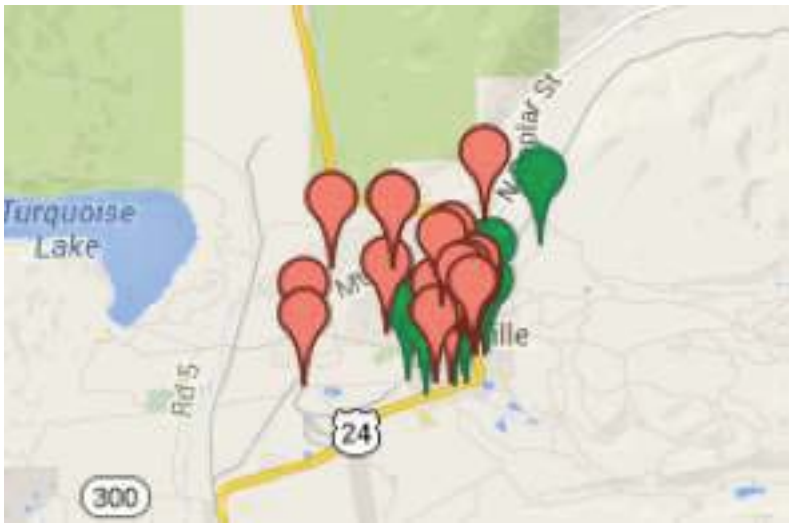

Figure 17 Actual broadband speeds that meet the FCC's definition of broadband occur only in close proximity (less than 1 mile) from the CenturyLink central office. Comcast buys its middle mile services from CenturyLink's central office.

Demand Mapping: An Assessment of Needs

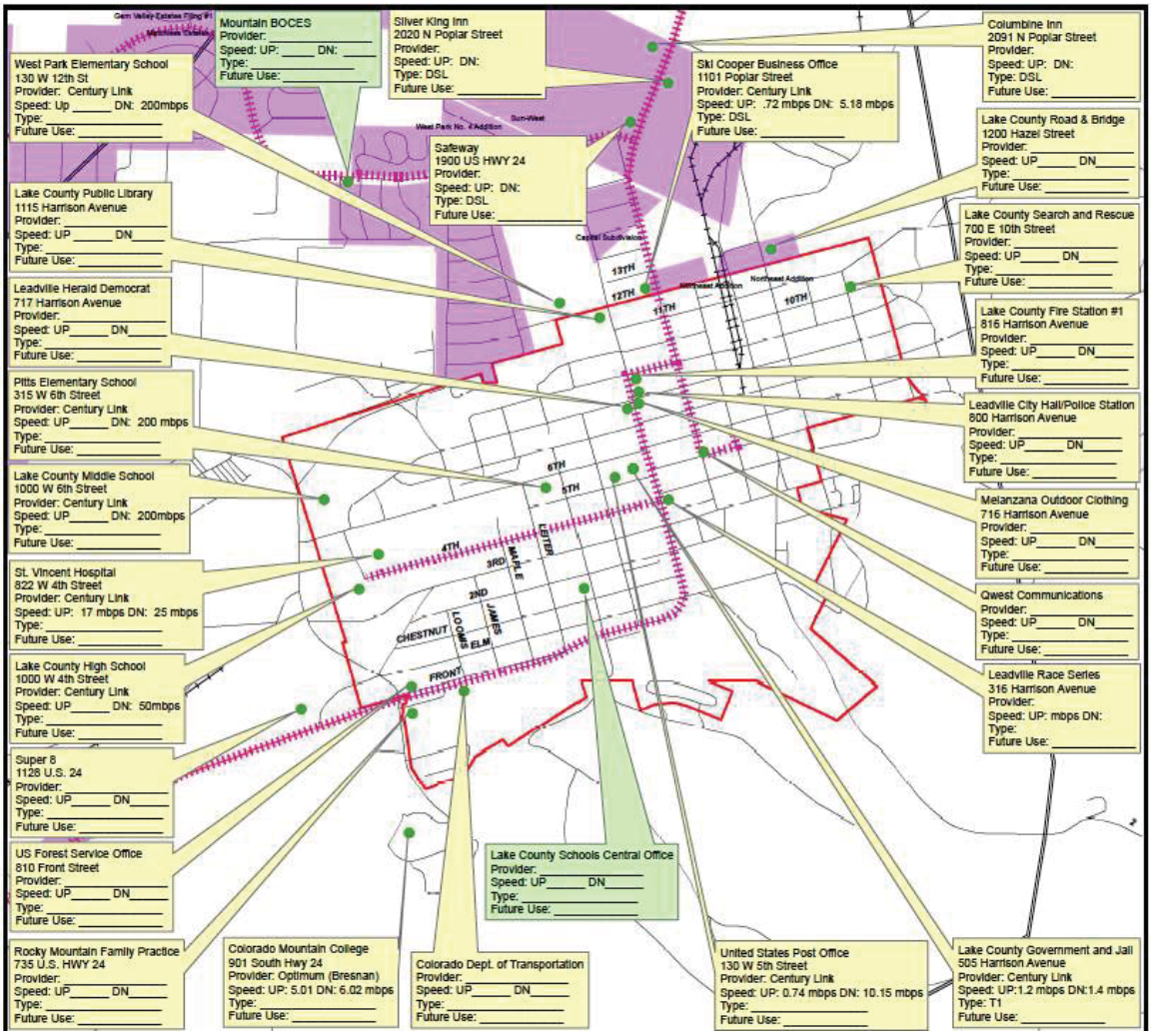

Figure 18 Inventory of community anchors in Leadville that subscribe to relatively large quantities of bandwidth representing relatively high levels of demand for last mile services

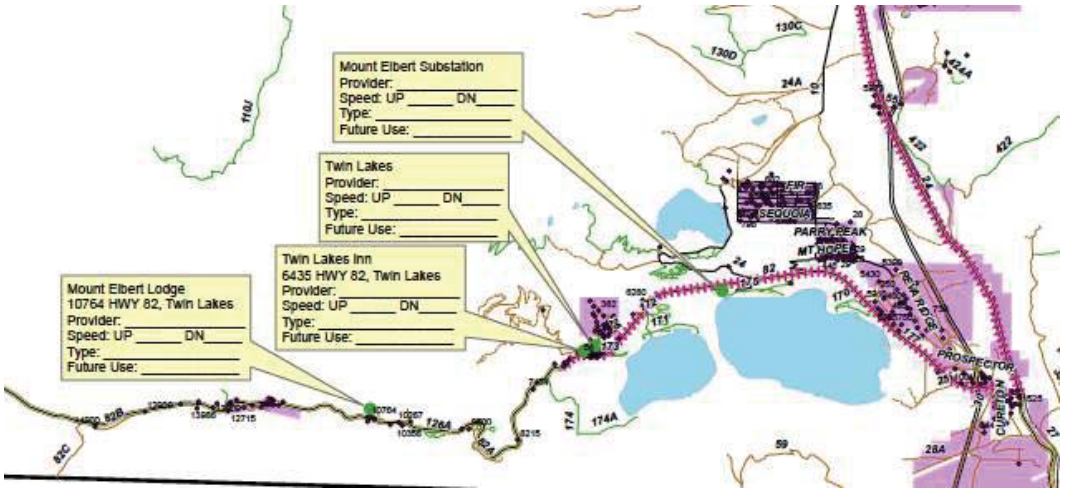

Figure 19 Demand Map for community anchors of south Lake county

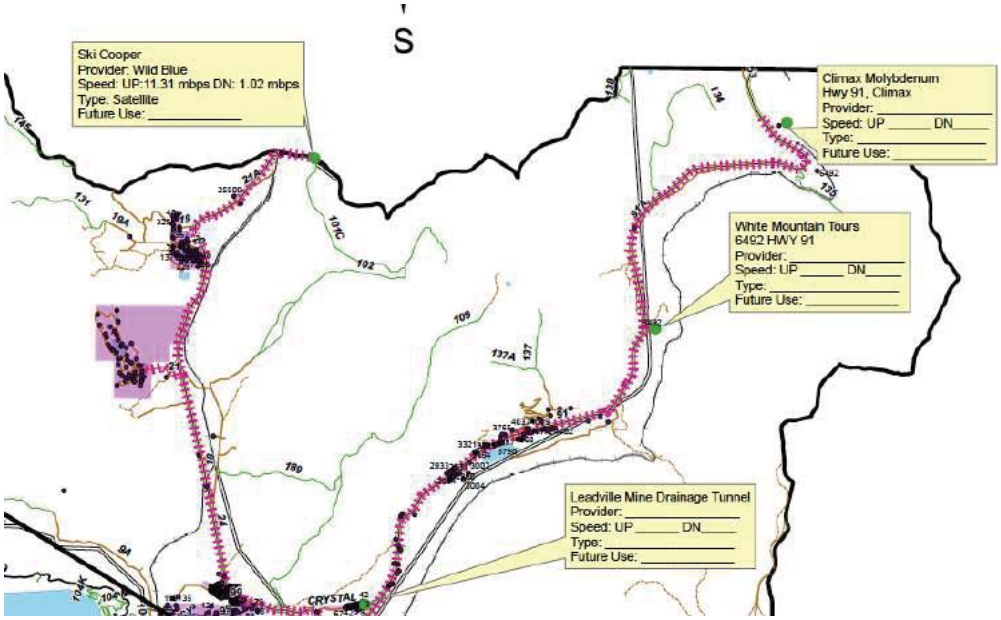

Figure 20 Demand Map for north Lake County community anchors

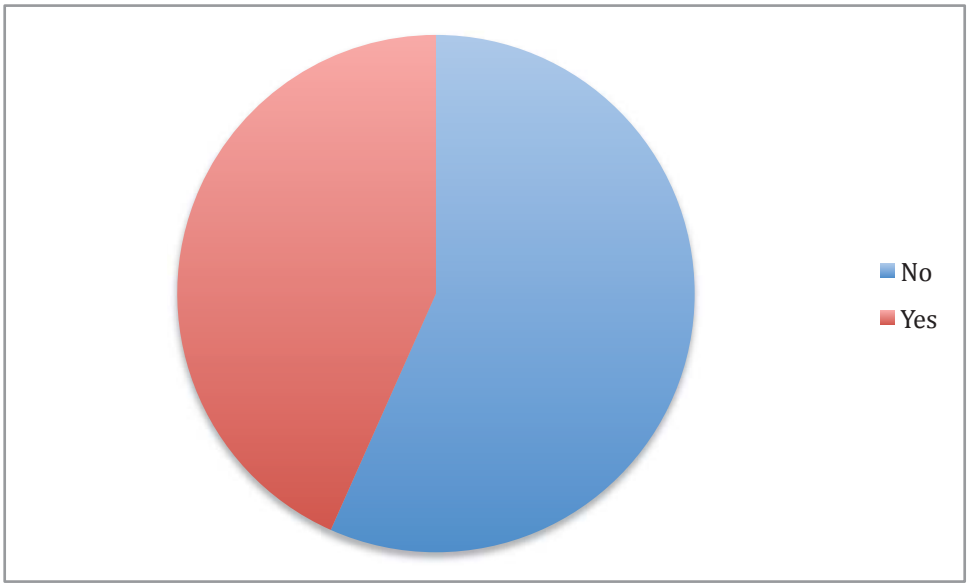

Figure 21 Over half of respondents are not satisfied with their internet service.

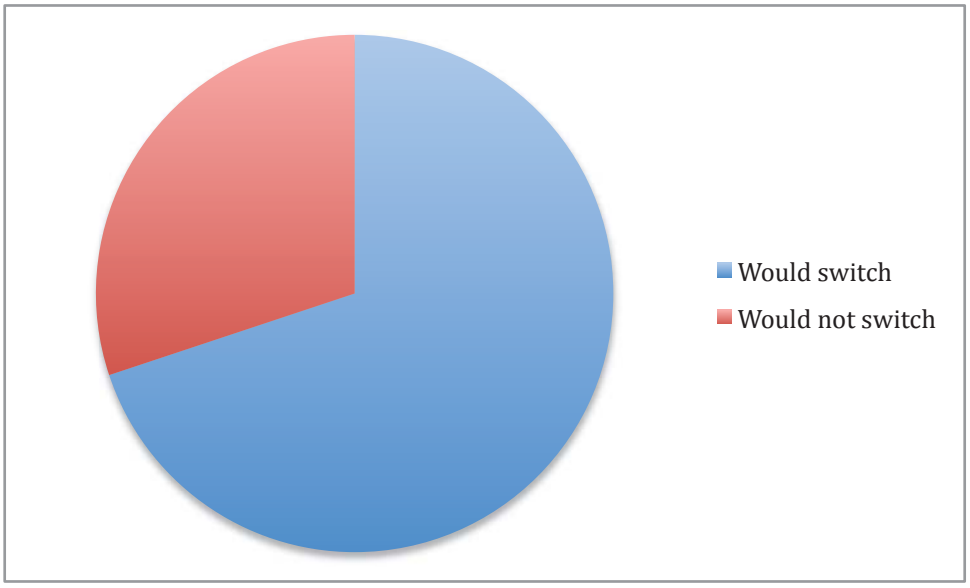

Figure 22 Two-thirds of respondents would switch to a new service provider if it offered faster speeds at about the same price

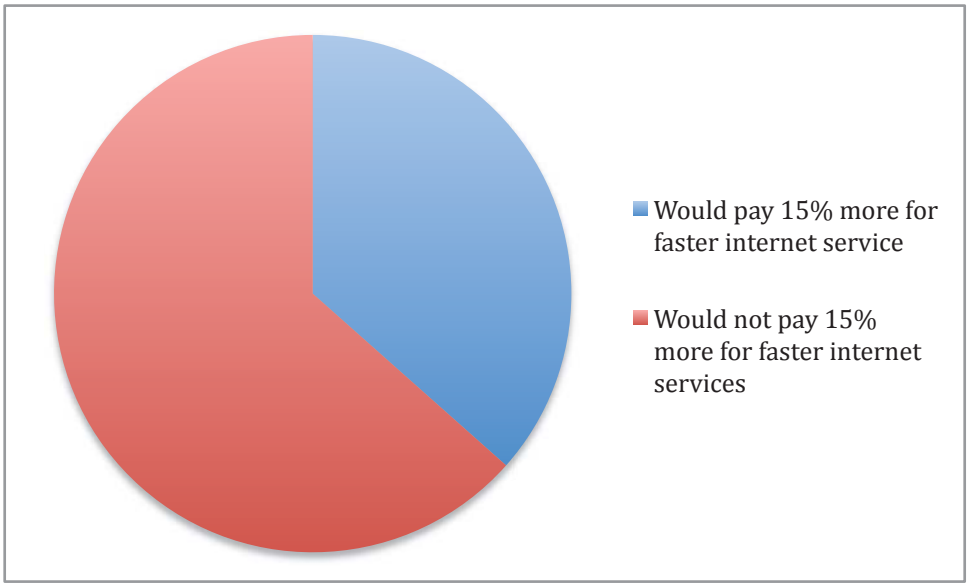

Figure 23 One-third of respondents said they would pay up to 15% more for faster internet service

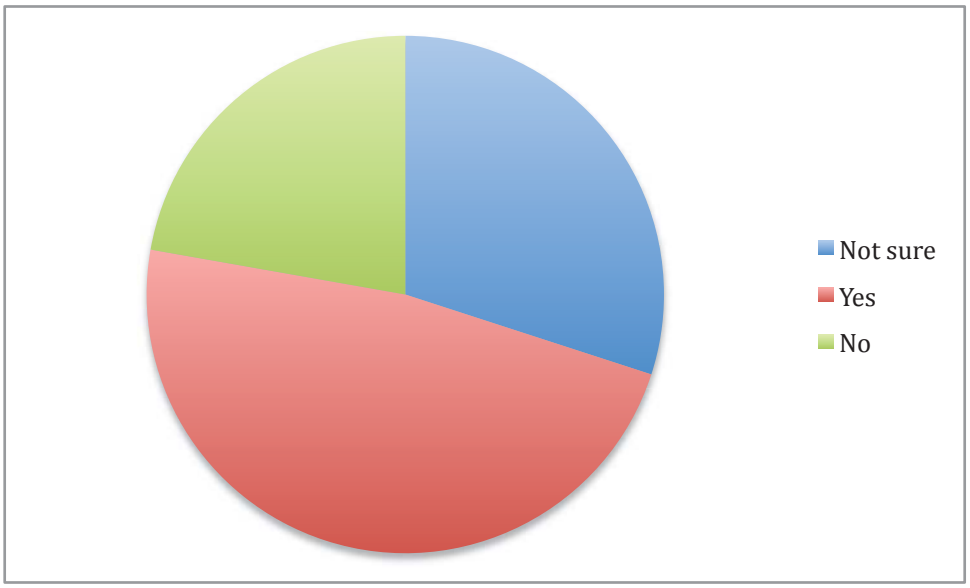

Figure 24 About half of respondents are subscribed to the fastest speeds possible for their market

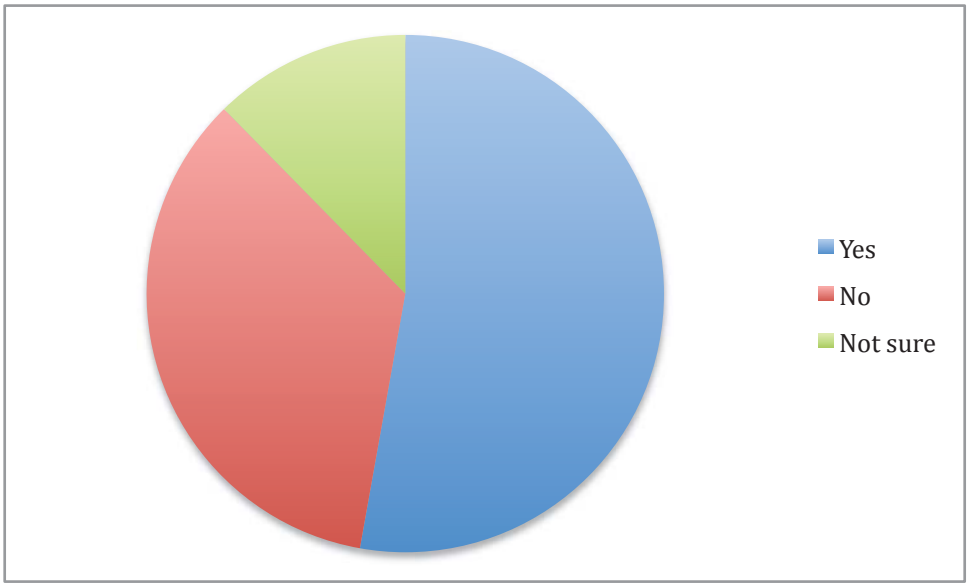

Figure 25 About half of respondents report they have a choice in service providers

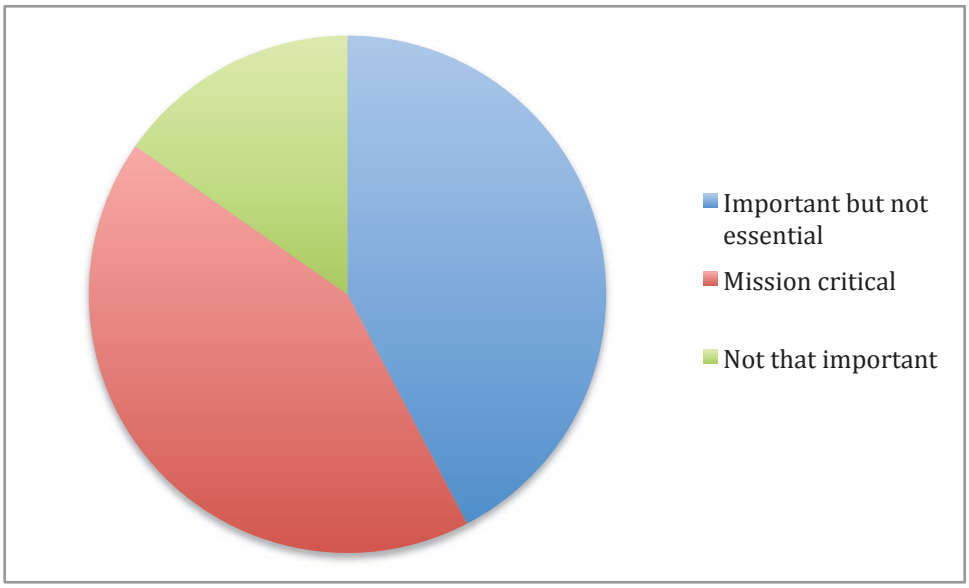

Figure 26 Half of respondents consider faster internet service to be mission critical for their business

Most businesses and community anchor institutions pay (relative to Denver prices) extremely high prices for (relative to Denver) for very slow internet speeds and unreliable service (frequent outages).

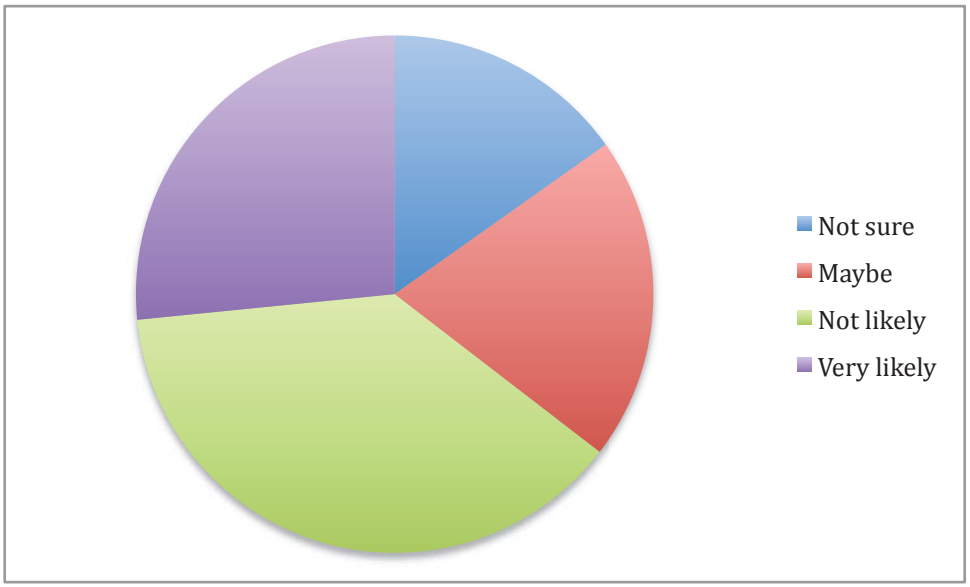

Figure 27 About one-quarter of respondents would be very likely to expand their business if they had access to faster internet services

Communication between suppliers and potential subscribers detailing a) availability of services b) speeds of services c) pricing of services and d) reliability of services might remedy the differences between expectations and what's available in this market.

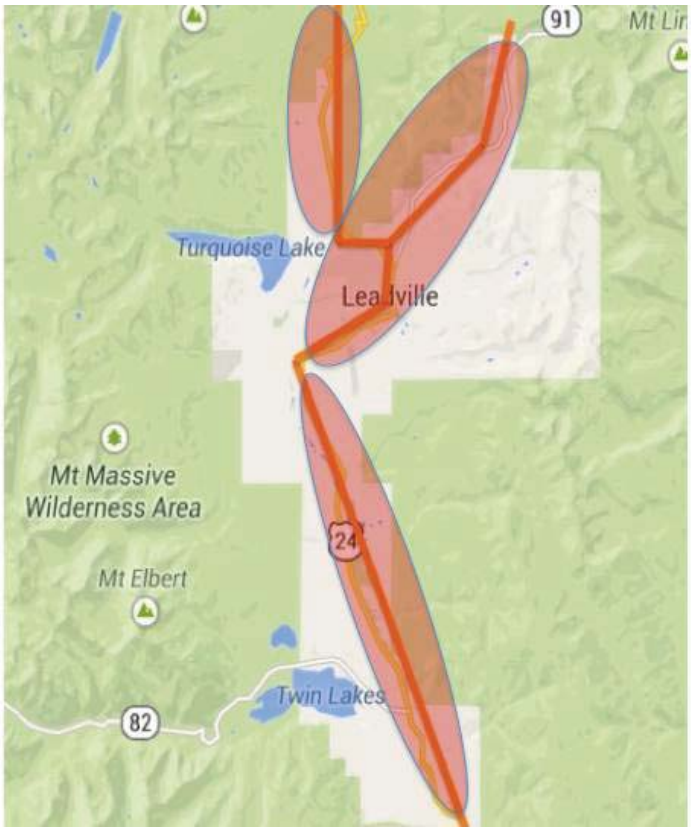

Figure 28 Given CenturyLink fiber assets in Lake County, a fiber-to-the-home (FTTH) deployment along its fiber route is possible. In addition, FTTH services could be deployed via aerial fiber via the power grid (Xcel and Sangre de Cristo)

Recommendations: Next Steps

1. Once approved by Lake County government, this report and especially the results of the surveys should be made available to the public (downloadable from county government websites). Issuance of a press release to local and state media will lay the foundation for Recommendation #2 below.

2. A Request for Information (RFI) should be issued by Lake County to local and national service provider communities inviting proposals to better serve the communities of Lake County. This serves as an online auction of demand in exchange for service.

Appendix A: Request for Information (RFI)-What Can Service Providers Offer Community Anchors of Lake County?

Question/Factor	Your Response
1. What technology type(s) do you propose?	
2. How will your middle mile solution be redundant (north-south, east-west) and offer 99.999% availability in support of your last mile services?	
3. Does your solution enable a commercial or institutional end user to subscribe to speeds of up to 1 Gbps services?	
4. What price range would an enterprise customer expect to pay in $/Mbps/month per location for your services if buying:	
a. 10 Mbps?	
b. 50 Mbps?	
c. 100 Mbps?	
d. 500 Mbps?	
e. 1 Gbps?	
5. How do you propose to service the community anchor institutions of Lake County (see attached Broadband Assessment for names and addresses)?	
6. What public sector concessions would assist you in service delivery? How would you use those assets to bring better internet services to these communities? Please explain.	
a. Access to light poles?	
b. Access to rights of way?	
c. Roof rights on public sector buildings?	
d. Access to public safety wireless	

towers?	
e. Access to a publicly-owned space for a carrier neutral location (CNL) as alternative to central office? If so, please describe.	
f. Local government assistance in obtaining pole rights from electric service provider(s)?	
g. Access to existing indoor Distributed Antenna System (DAS) in public buildings?	
7. Does your solution include publicly accessible Wi-Fi solution? If so, please describe.	
8. Does your solution include or support a Distributed Antenna System (DAS, Wi-Fi/cellular or Wi-Fi only)?	
9. Does your solution include or support 4G cellular services?	
10. Can you deliver service to community anchor institutions and leading businesses in Lake County by September 01, 2014?	
11. In addition to servicing the enterprise customers of Lake County, how does your solution bring improved last mile internet and mobile (cellular) services to the residential and small business markets of these counties?	
12. Can your last mile service provide low cost internet access for students enrolled in the Lake County school district? If so, what is your suggested subscription price for families with students on free and reduced lunch?	
13. Please provide a proposed service level agreement for enterprise customers of Lake County.	

Appendix B: Comments from Survey Respondents-Residential

The most valuable data collected from surveys comes in the “Comments” section.